

# ENOUGH

EUROPEAN FOOD CHAIN SUPPLY  
TO REDUCE GHG EMISSIONS BY 2050





ENOUGH Webinar  
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## **WP6**

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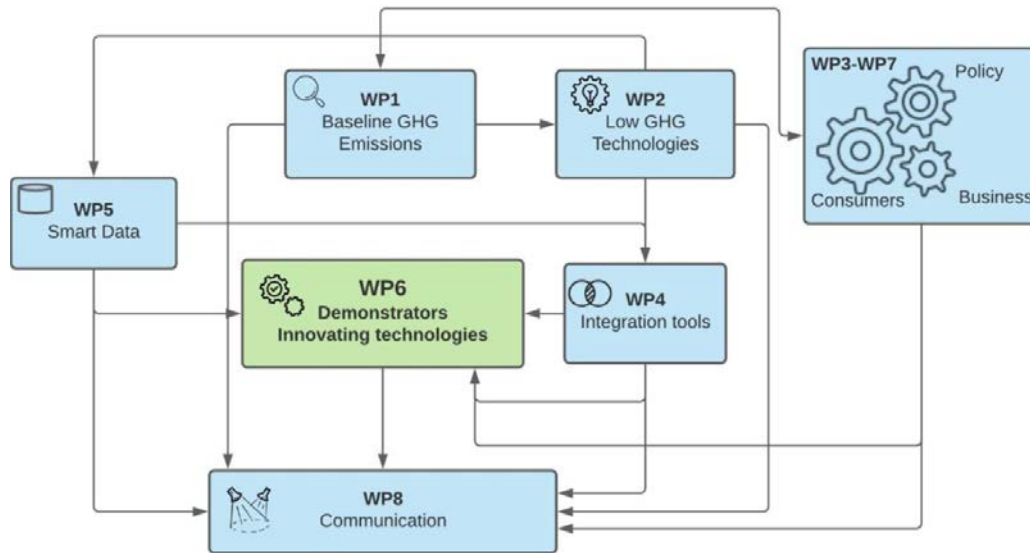
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# WP6 – Demonstrations of best technologies in key products and cross sectors

**Objective : Demonstrate relevant and viable TRL5-7 decarbonisation technologies to the European food industry**

Objective : Provide the European food industry with tools to help them decarbonise

Objective : Communicate information emanating from the project widely to food companies, policy makers and interested groups













# WP6 – Demonstration matrix and selected demo cases

WP6 is based on demonstration of key technologies and strategies in relevant or operational environment

Where we are: **14 demonstrators** started in 2021, **4 new demonstrators** approved in September 2022

Some new demos under evaluation

	Meat (Task 6.1)	Fish (Task 6.2)	Dairy (Task 6.3)	Fruit&Veg (Task 6.4)	Other
Process					
Transport (Task 6.5)					
Storage & Retail (Task 6.6)				 	
Domestic (Task 6.7)	 				

# WP6 – Sustainable technologies under demonstration

Actions			
Reduce energy demand Optimize Energy Flows Eliminate Fossil Fuels	Improve Energy Efficiency	Use sustainable working fluids and materials	Improve preservation conditions Reduce food waste

## Technologies



High Temperature Heat Pumps HTHP,  
Heat Recovery, Renewables,  
Electric refrigeration systems for transport



Thermal Energy Storage TES,  
Demand Side Response DSR



Dynamic Controlled Atmosphere DCA,  
Freeze Drying, Brine Freezing, Blast  
Freezing, Superchilling



Climate neutral packaging



Advanced Components



Advanced control to  
integrate and optimize  
technologies

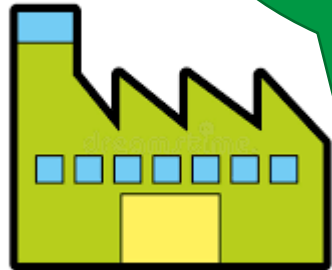
# WP6 – Targets and Technologies

ENOUGH Technology under demonstration	Present Technology
High Temperature Heat Pump HTHP	Fossil Fuel burners
Integrated management of thermal flows, Thermal Energy Storage TES , Heat Recovery	Separate Chilling and Heating
Natural refrigerants NWF	Synthetic Refrigerants
Electrically driven refrigerating systems, renewables	Combustion Engine driven refrigeration systems in transport
Demand Side Response DSR & Thermal Energy Storage TES	Instantaneous/rigid electrical energy supply -no integration with the grid
Climate neutral packaging	High carbon packaging materials
Dynamic Controlled Atmosphere	Controlled atmosphere
Brine freezing, blast freezing at low temperature	Long- time freezing by air
Vacuum drying	Air drying
Superchilling	0°C meat storage

# WP6 –ENOUGH technologies to build the 2050 food chain

## PROCESSING

HThP, Heat recovery,  
Natural Refrigerants,  
Renewables,  
Brine freezing, Blast  
freezing



## TRANSPORT

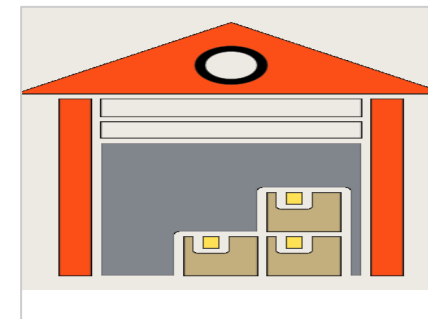
Electrically driven  
refrigeration system,  
Natural refrigerants,  
PV, TES, Climate  
Neutral Packaging



Advanced  
control

## STORAGE

Heat Recovery,  
Natural  
Refrigerants, DCA,  
Climate Neutral  
Packaging



# WP6 – ENOUGH technologies to build the 2050 food chain

...continues



## RETAIL

Heat recovery, DSR,  
TES, Renewables  
Natural Refrigerants,  
Superchilling, Climate  
Neutral Packaging



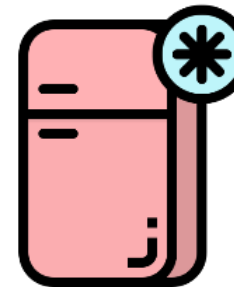
## LAST MILE DELIVERY

Electric vehicle,  
TES

Advanced  
control

## DOMESTIC

Advanced  
components,  
natural refrigerants,  
vacuum freezing,  
DSR





# What have we achieved so far?

## An overview on first results

# HTHP - DEMO 14 –Osenbrück 4.0

- Technology : HTHP (hybrid  $\text{NH}_3\text{-H}_2\text{O}$  absorption-compression heat pump HACHP)
- Goal: 150°C steam production heat pump for fossil fuel burner replacement
- Product: meat
- Chain Link: processing
- Status: prototype in the lab- ready for running

## First results

- The construction of the test facility and installation of measurement sensors have been completed.
- System commissioning with  $\text{N}_2$  has been conducted.
- The system has been charged with ammonia and water.
- **First test will be conducted on Dec.2<sup>nd</sup> 2022**



# NWF & Heat Recovery - DEMO 2- DAIRY NORWAY

- Technology: CO<sub>2</sub> chiller with Heat Recovery (CIP and DHW)
- Goal: Integration of energy flows, TES, use of NWF
- Product : Dairy
- Chain Link: Processing
- Status: Field test running



## First results

- Monitoring the energy flows in key heating and cooling devices
  - All flow meters and temperature sensors are installed
  - Verification of measurement equipment end of November
  - Access to the monitoring platform in progress
- First results expected at the end of the year and will be presented in January



...more on Technologies for Dairy in the next presentation

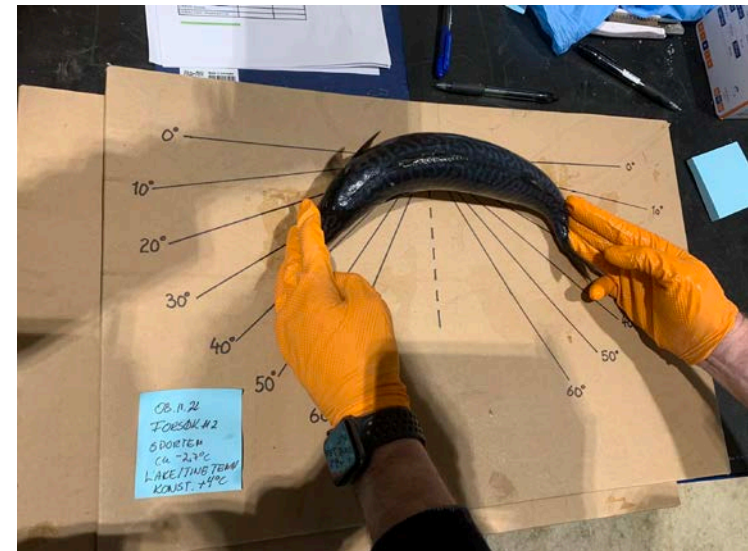
# Reducing energy demand and freezing time – Demo 15 – Brine freezing of fish

- Technology: Brine freezing
- Goal: reducing energy demand and shorten freezing times
- Products: fish
- Chain Link: processing
- Status: prototype in lab



## First results

- Testing flexibility of fish after freezing in brine
- Packing in boxes (necessary for next process step)





# DCA- DEMO 5-RQ based DCA storage

- Technology: Respiratory Quotient RQ based Dynamic Controlled Atmosphere DCA
- Goal: Reduction of food losses and energy demand reduction
- Product : fruit& vegetables
- Chain Link: storage
- Status: field test running

## First results

- RQ-DCA systems demo sites up and running
- RQ measurements started on 6 commercial 200 metric ton rooms
- Fruit samples taken for quality analysis and comparison with Ultra Low Oxygen storage in spring



# Electric transport refrigeration unit -Demo 6-Fresh and Green Delivery

- Technology: Natural Working Fluid refrigeration, Renewables (Photovoltaic PV)
- Goal: Electrically powered refrigeration in place of diesel motor, no synthetics
- Products: all (fresh & frozen)
- Chain Link: transport
- Status: prototype in lab/components optimisation

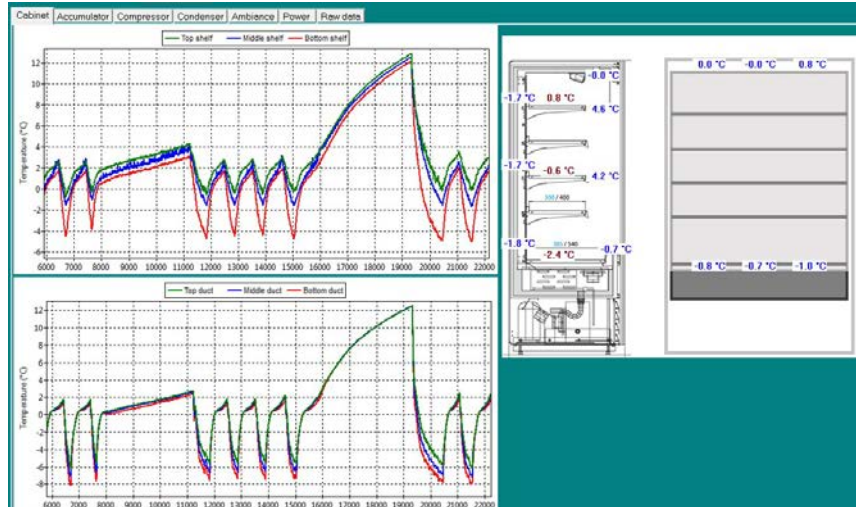
## First results

- Design of CO<sub>2</sub> Medium Temp +Low Temp unit with single compression stage
- Design and optimization of specific components (MT and LT ejectors) is done, experimental tests expected in next months
- Preliminary numerical assessment of the cooling unit performance, dynamic model under development



# TES –Demo 11- Thermal storage unit for refrigeration cycle

- Technology: Thermal Energy Storage TES and Demand Side Response DSR
- Goal: flexible interaction with the grid
- Products: all (fresh)
- Chain Link: retail
- Status: prototype in lab

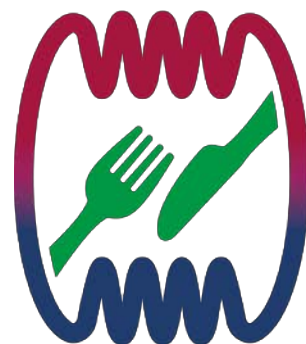


## First results

- Prototype operational
- Energy consumption measured lower with thermal storage unit
- When discharging, food temperature can be kept at safe values for a few hours
- The design could be optimized with an increase of refrigerating power during discharge around 30%



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 101036588



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## THANK YOU !

[More details on demonstrators](https://enough-emissions.eu/demonstration-sites-list/)

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[enough-emissions.eu](https://enough-emissions.eu)